

Department of Energy Beryllium Worker Registry



EFCOG/DOE CHEMICAL MANAGEMENT 2003
WORKSHOP, November 4 – 6, 2003

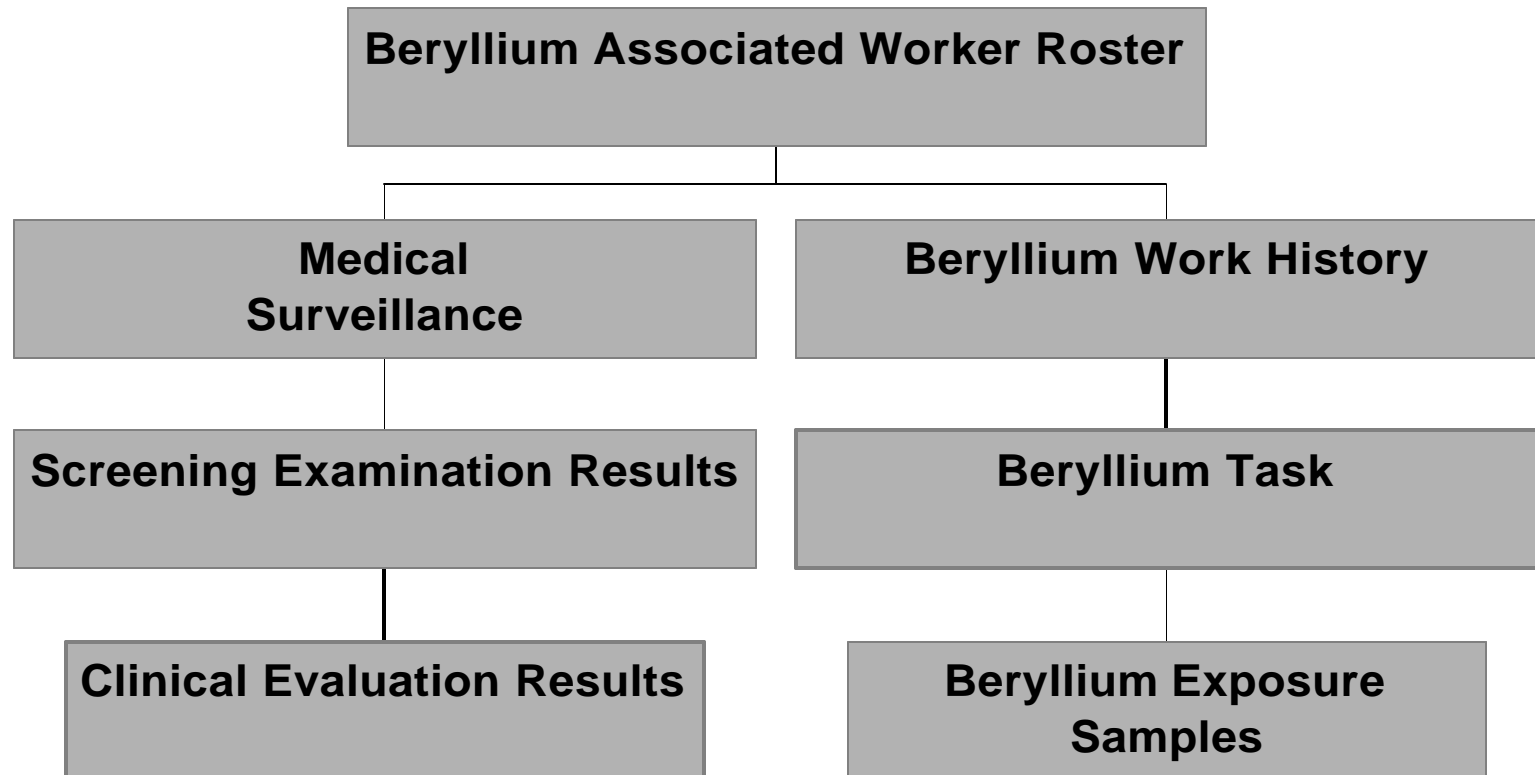
Paul Wambach, Department of Energy
David Weitzman, Department of Energy
Phillip Wallace, Oak Ridge Institute for Science and
Education (ORISE)

Tables in the Beryllium Registry



- ⌘ Roster
- ⌘ Medical Surveillance
- ⌘ DOE Beryllium Work History
- ⌘ DOE Beryllium Task
- ⌘ DOE Beryllium Exposure

Table Relationships



Linear Regression

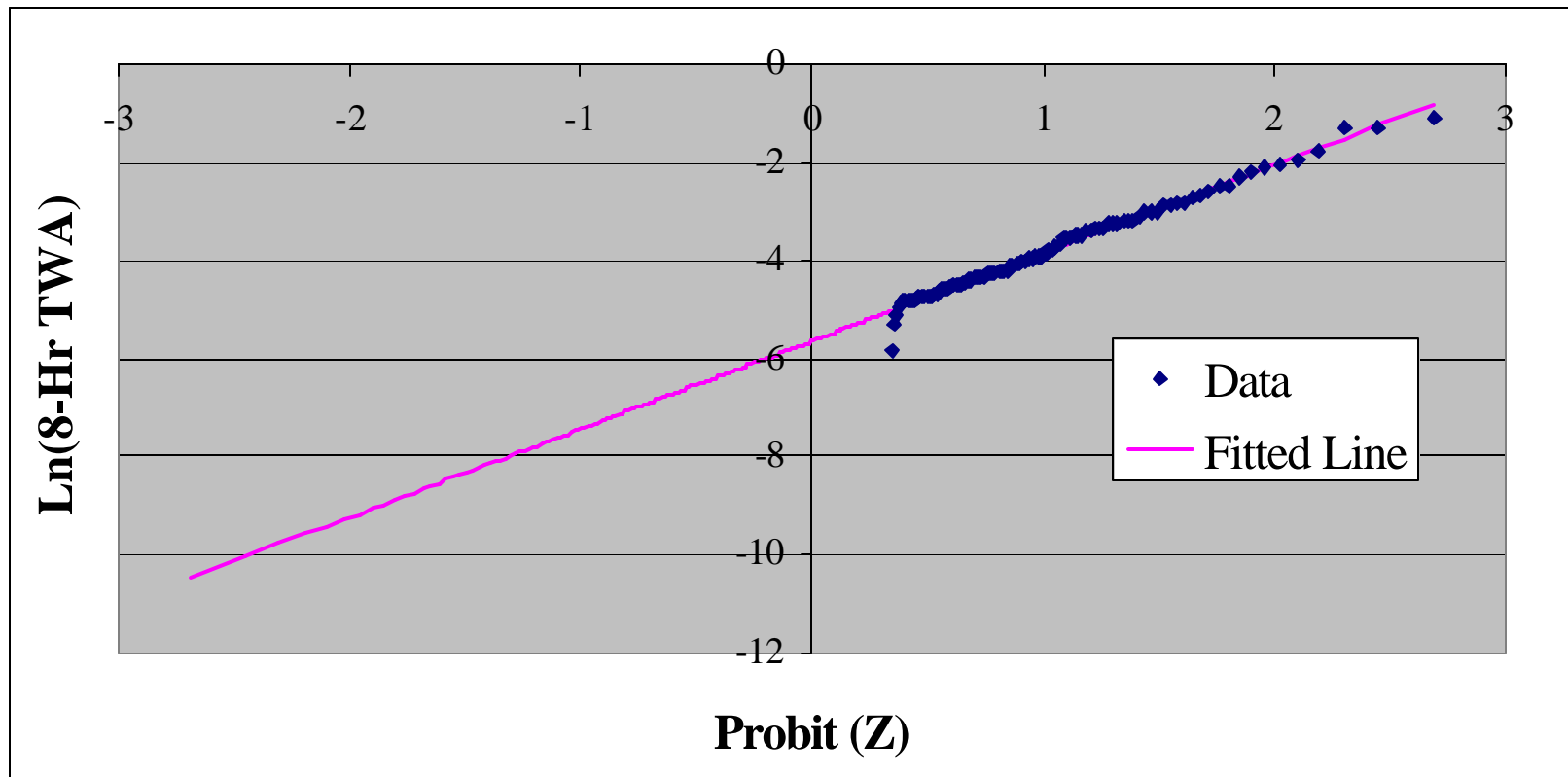
Sandia National Laboratory Be Workers

- ⌘ Probit (z) =
 $\text{Normsinv}(\text{Rank}/n+1)$
- ⌘ Geometric Mean =
 $\text{Exp}(\text{Intercept})$
- ⌘ Geo. Std. Dev. =
 $\text{Exp}(\text{X Variable})$
- ⌘ Fitted Line = Intercept +
(Variable x Probit)

<i>Regression Statistics</i>	
Multiple R	0.994
R Square	0.988
Adjusted R Square	0.988
Standard Error	0.108
Observations	105
ANOVA	
	<i>df</i>
Regression	1
Residual	103
Total	104
<i>Coefficients</i>	
Intercept	-5.637
X Variable 1	1.884

Log Probability Plot

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Maximum Likelihood Estimate

AIHAJ 62:195-198



AIHAJ 62:195-198 (2001)

Ms. #173

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Exposure Estimation in the Presence of Nondetectable Values: Another Look

A common problem faced by industrial hygienists is the selection of a valid way of dealing with those samples reported to contain nondetectable values of the contaminant. In 1990, Hornung and Reed compared a maximum likelihood estimation (MLE) statistical method and two methods involving the limit of detection, L . The MLE method was shown to produce unbiased estimates of both the mean and standard deviation under a variety of conditions. That method, however, was complicated, requiring difficult mathematical calculations. Two simpler alternatives involved the substitution of $L/2$ or $L/\sqrt{2}$ for each nondetectable value. The $L/\sqrt{2}$ method was recommended when the data were not highly skewed. Although the MLE method produces the best estimates of the mean and standard deviation of an industrial hygiene data set containing values below the detection limit, it was not practical to recommend this method in 1990. However, with advances in desktop computing in the past decade the MLE method is now easily implemented in commonly available spreadsheet software. This article demonstrates how this method may be implemented using spreadsheet software.

Maximum Likelihood Estimates

Sandia National Laboratory Be Workers

⌘ Geometric Mean 0.0056 $\mu\text{g}/\text{m}^3$

⌘ Geometric Std Dev 4.64

⌘ Arithmetic Mean 0.018 $\mu\text{g}/\text{m}^3$

⏏ Method for calculating confidence interval not available for MS Excel

⌘ Geometric Upper Tolerance Limit 0.107 $\mu\text{g}/\text{m}^3$

⏏ By $\text{EXP}(\ln \text{GM} + K * (\ln \text{GSD}))$

⏏ $K = (Z_p + (Z_p^2 - (a * b))^{0.5}) / a$

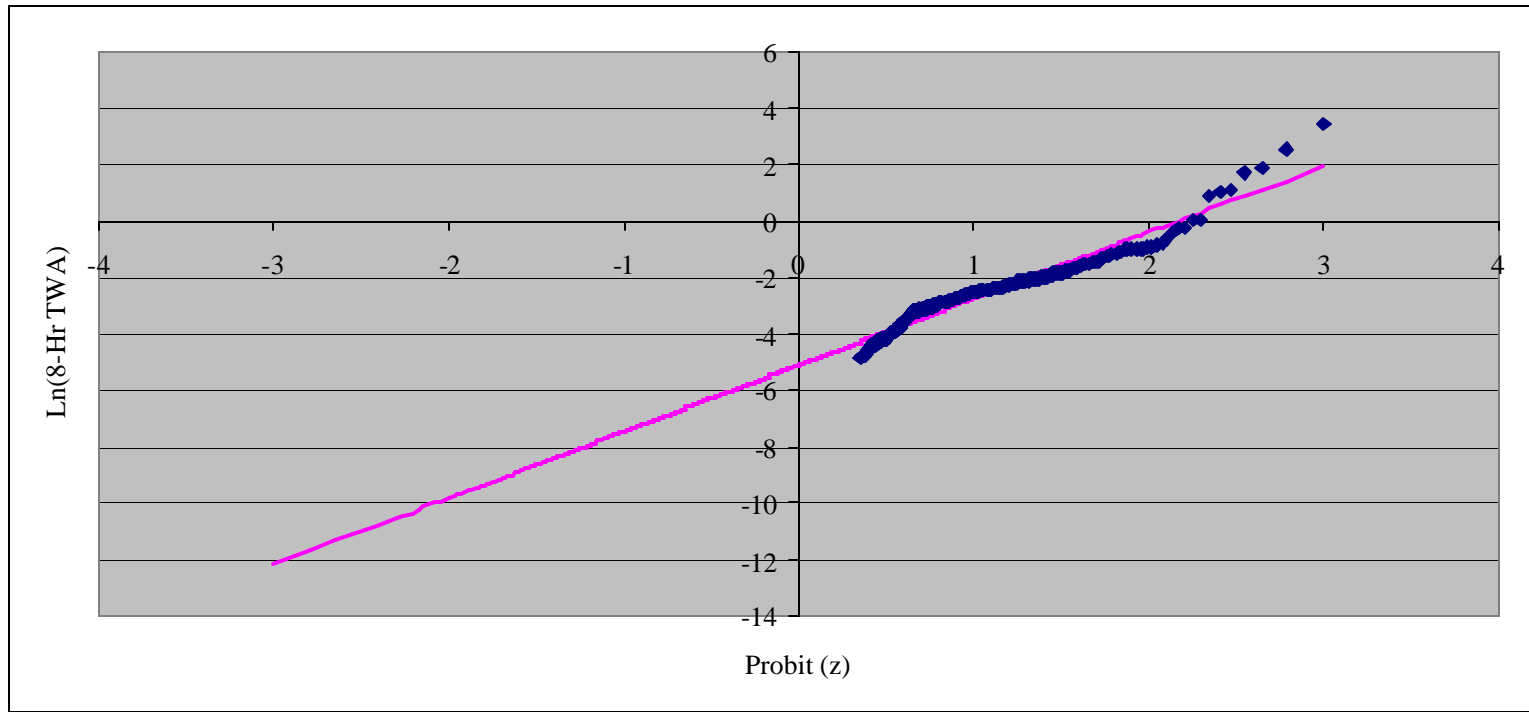
⏏ $a = 1 - Z_g^2 / (2 * (n - 1))$

⏏ $b = Z_p^2 - (Z_g^2 / n)$

Distribution Free Estimates

Y-12 Be Workers 2001

⌘ Regression Statistics - R Square = 0.947



95% Distribution-Free Upper Tolerance Limit of the 95th%

Use: sort the data and count the number of observations.

Enter the number of observations and desired content and confidence below.

The nonparametric tolerance limit is sorted observation (order statistic) as given below.
Achieved content (at target confidence) and vice versa are also given.

Number of observations

741

Content desired (e.g. 95%):

95.0%

Confidence desired (e.g. 99%):

95.0%

**NP Tol Limit is observation #
or, counting down from largest**

714

28

Achieved content at target confidence =

95.01%

Achieved confidence at target content =

95.12%

Kaplan-Meier Survival Analysis



- ⌘ Provides distribution-free estimates of the mean and confidence interval for censored data
- ⌘ Used in clinical trials, life insurance underwriting, and materials testing
- ⌘ Can be performed with MS Excel

Distribution-Free Estimates

Y-12 Be Workers 2001



	Rank	Result
⌘ Minimum	1	ND
⌘ Median	371	ND
⌘ LOQ	475	0.0077 $\mu\text{g}/\text{m}^3$
⌘ Upper Tolerance Limit	714	0.286 $\mu\text{g}/\text{m}^3$
⌘ Maximum	741	29.85 $\mu\text{g}/\text{m}^3$
⌘ K-M Mean		0.126 $\mu\text{g}/\text{m}^3$
⌘ 90% Confidence Interval		0.051 - 0.201 $\mu\text{g}/\text{m}^3$

Prevalence of Beryllium Sensitization

Current Employee Programs	Number of Individuals Tested	Confirmed Positive Be-LPT	Diagnosed CBD	Prevalence of BeS
Oak Ridge National Lab.	93	0		0.0%
Sandia National Lab.	222	0		0.0%
East Tenn. Tech. Park (K-25)	228	2		0.9%
Kansas City Plant	980	13	2	1.3%
Pantex	1239	19	4	1.5%
Nevada	641	13	1	2.0%
Hanford	573	16	4	2.8%
Oak Ridge Y-12	616	20		3.2%
Lawrence Livermore National Lab.	150	5		3.3%
Rocky Flats	729	27		3.7%
Total	5471	115	11	2.1%

Conclusions



- ⌘ Despite a high proportion of non-detected results, reasonable estimates of mean and upper tolerance limit of exposure levels can be made.
- ⌘ Differences in the prevalence of beryllium sensitization and disease between sites creates the opportunity to determine safe exposure levels.

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